CHAPTER IV.

EXPERIMENTS OF OTHER AUTHORS.

Several authors have studied the behaviour of the atomic scattering factor in the region of anomalous dispersion. The first who showed such an anomaly in the scattering factor were MARK and SZILARD [1]). They made reflections in the first order at the octaeder plane of RbBr with a wave length lying between the K-absorption edges of Rb and Br. This reflection has the intensity zero if the wave length lies far away from the absorption edges of the elements. In this special case it appeared with remarkable intensity.

ARMSTRONG [2]) and WYCKOFF [3]) determined for some wave lengths the f-factor of Fe, Cu and Ni for the reflections in several orders by comparing the intensities of the reflections with the intensity of the reflection from the 200-plane of a rocksalt crystal. From these measurements it could be concluded that the f-factor is no longer constant if the radiation used lies in the neighbourhood of an absorption edge of the scattering element.

Another method was employed by GLOCKER and SCHÄFER [4]), who determined the absolute values of the f-factor by making DEBYE-SCHERRER records of a mixture of the element under investigation (viz. Fe) and an element for which at the wave lengths used no anomalies are to be expected and for which therefore the f-factor is known. As standard element they used Al. Now the intensities of the reflections of Fe and Al are compared. After correcting for the reflecting power and the absorption of the powder they get f-values for several deflection angles. They find at first that the influence of the anomalous dispersion varies with the deflection angle to a high degree. In extrapolating they find the f-factor for deflection angle zero. Theoretically they calculated in an analogous manner as COSTER, KNOL and PRINS the f-factors for this deflection angle. The agreement for wave lengths longer than that of the absorption edge was sufficiently good. At the short wave length side a discrepancy was found, the f-factors there having too low a value.

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[1]) H. MARK and L. SZILARD, ZS. f. Phys. *33*, 688, 1925.

[2]) A. H. ARMSTRONG, Phys. Rev. *34*, 931, 1929.

[3]) R. W. G. WYCKOFF, Phys. Rev. *35*, 215, 583, 1930; *36*, 1116, 1930.

[4]) R. GLOCKER and K. SCHÄFER, ZS. f. Phys. *73*, 289, 1932.

BRADLEY and HOPE [1]) determined the atomic scattering factor of Fe with the aid of Al, which formes with Fe a compound FeAl. Then they got in even order reflections for the structure factor of FeAl $f_{Fe} + f_{Al}$ and in odd order $f_{Fe} - f_{Al}$. However, they did not take into account the phase differences caused by the scattering at the individual atoms. Theoretically this fact has been discussed by COSTER and KNOL [2]). BRADLEY and HOPE did not find such a discrepancy as GLOCKER and SCHÄFER did.

Meanwhile SCHÄFER [3]) has given an explanation of the discrepancy mentioned. Usually the only condition for the fineness of the powder is this that the crystal regions are so small that no extinction can occur. Now in general for a rather fine powder the condition is satisfied because the individual grains often consist of several crystal regions. But as SCHÄFER remarks, the grains must also satisfy another condition, viz. that they are fine enough to permit speaking for a mixture of two powders of an average absorption coefficient. This fact was not taken into account in the first publication of GLOCKER and SCHÄFER. SCHÄFER discusses the influence of the fineness of the powder on the intensity of reflection and explains why their first results gave at the short wave length side too low a value and and how the deviation from the normal f-value depends upon the deflection angle. He performs new measurements with a sufficiently fine Fe powder and finds that the discrepancy has disappeared. The new values are compared with the theory of HÖNL. SCHÄFER concluded that the agreement of his results, especially for radiation at the long wave length side of the absorption edge, was much better with this theory than with the λ^3-law. However, in using the λ^3-law SCHÄFER, assumed for the oscillator strength of the K-edge the number of K-electrons viz the value 2. We have already mentioned in chapter I that in using a λ^3-law it is necessary, in order to remain in agreement with the experiments, to assume for the oscillator strength of the K-edge the number 1.3. If this is taken into account the agreement also with the λ^3-law is sufficiently good.

RUSTERHOLZ [4]) has in the same manner investigated the f-factor

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[1]) A. J. BRADLEY and R. A. H. HOPE, Proc. Roy. Soc. (A) *136*, 272, 1932.

[2]) D. COSTER and K. S. KNOL, Proc. Roy. Soc. (A), *139*, 459, 1933.

[3]) K. SCHÄFER, ZS. f. Phys. *86*, 738, 1933.

[4]) A. RUSTERHOLZ, ZS. f. Phys. *82*, 538, 1933.

for Cu at the long wave length side of the K-edge. He finds, with $N_K = 1.3$ a good agreement with the λ^3-law. In general the measurements of the various authors give a rather good agreement with the theory. For Fe our measurements too do not show a deviation from the theoretical decline of the f-factor. There remain still the deviations, found with Zn, in zincblende and in the single crystal of the metal. Though I have the impression that they are real, it seems not to be possible to give any theoretical explanation.

At the L-edges the experiments are very scarce. Here only GLOCKER and SCHÄFER and RUSTERHOLZ[1]) determined for Au and W the f-factor for a wave length at the long wave length side of the L-edge and far away from it. They found that the experimental f-factor was about 10 units lower than the f-factor of THOMAS-FERMI. The decline of the f-factor for several wave lengths is not studied. So nothing more can be said about this fact.

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[1]) A. RUSTERHOLZ, Helv. Phys. Act. *4*, 68, 1931.